UNIVERSITI SAINS MALAYSIA

Supplementary Examination
Academic Session 1997/98

April 1998

CSE401 - Artificial Intelligence

Duration : [3 hours]

INSTRUCTION TO CANDIDATE:

- Please ensure that this examination paper contains **NINE** questions in **EIGHT** printed pages before you start the examination.
- Questions No. **1, 2 and 3 are compulsory.**
- Attempt **any 5 questions** from question No. 4 to question No. 9.
- You can choose to answer either in Bahasa Malaysia or English.

ENGLISH VERSION OF THE QUESTION PAPER

1. Give brief answers (5 - 7 lines) to the following questions:

Attempt any 5 questions:

(a) Briefly describe Aristotle's 3 laws of tradition logic?

(b) What is the fundamental difference between conventional programming and programming in prolog?

(c) What is heuristics?

(d) What is an artificial neural network? List the components of a neural network?

(e) Briefly describe an expert system? Also show the architecture of an expert system?

(f) What are the two main areas of natural language processing?

(g) Given the following predicates, indicate the predicate symbol and the arity of each predicate:

(i) likes (computers).

(ii) computers.

(iii) friends (ahmad, ali, hasan).

(h) What are AND/OR graphs?

(i) What is resolution and how does it work?

(j) What is Predicate Calculus?

(k) In terms of knowledge representation, what is inheritance and how is it achieved?

(l) What is a semantic network?

(24 marks)

2. Fill in the blanks.

Note: Negative marking applies for this question (-1 for each incorrect answer).

(a) To implement the depth-first search algorithm, the Open list is maintained as a _____ data structure.

(b) Conceptual graphs allow us to represent specific but unnamed individuals by the use of a unique token called a _____ .

(c) In a neural network learning algorithm the _____ determines the speed of learning.

(d) The _____ is the person who designs, builds and tests the expert system.

(e) In an expert system, the _____ contains all the information about the current problem that is either supplied by the user or inferred by the system.

(f) In natural language processing, _____ is an activity that checks the ordering of the linguistic tokens against a grammar.

(g) The Universal Quantifier indicates that the sentence is True FOR _____ values of the variable.

(h) Prolog stands for _____ .

(8 marks)

3. Determine whether the given statements are **True or False**.

Note: Negative marking applies for this question (-1 for each incorrect answer)

(a) Depth-first search explores the state space in level-by-level fashion.

(b) The list data structure in Prolog can contain duplicate (repeated) elements.

(c) The cut (!) predicate is always true.

(d) In a frame, the slots identify properties of an object or concept.

(e) In a neural network each unit can have more than one input line.

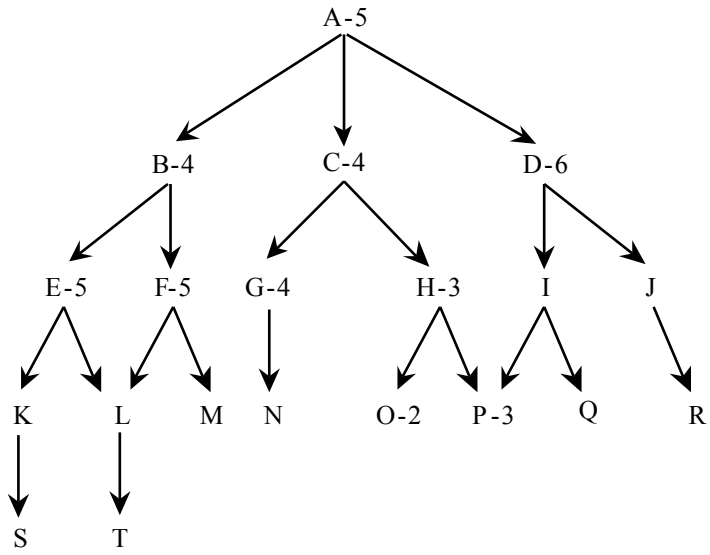
(f) Conceptual graphs have labelled arcs.

(g) The knowledge base is the processor in an expert system and it derives all the solutions.

(h) In natural language processing, the analysis of the intent of a dialogue is known as prosody.

(8 marks)

4. (a) Show the complete trace of Best-First Search algorithm for the given graph. The desired goal is the state P.



(4 marks)

(b) Write the pseudocode for the depth first algorithm?

(4 marks)

(c) Draw the AND/OR Graph to represent the following expressions?

a
b
c
d
e
b ∩ c → f
c ∩ d → g
b ∩ f → h
d ∩ g → i
f → i
a ∪ h → k
i ∩ e → l
g ∪ e → j
j → l

(4 marks)

5. (a) Determine using truth tables whether the following two expressions are equivalent or not?

EXPRESSION 1: (¬P ∪ Q) = (P → Q)
EXPRESSION 2: (P ∪ ¬Q) = (¬P → ¬Q)

(3 marks)

(b) Use Resolution on the following statements:

- ¬ pass (X, history) ∪ ¬ win (X, lottery) ∪ happy (X)
- ¬ study (Y) ∪ pass (Y, Z)
- ¬ lucky (W) ∪ pass (W, V)
- ¬ study (john)
- lucky (john)
- ¬ lucky (U) ∪ win (U, lottery)

to prove:

John is happy { happy (john) }

(5 marks)

(c) Prove that the given logical expression is a legal sentence?

Expression: ((P ∩ Q) → R) = ¬P ∪ ¬Q ∪ R

(4 marks)

6. (a) Write simple prolog programs to:

(i) Delete an item (say X) from a list, say L1

(ii) Concatenate two list, say L1 and L2 to give a new list L3

(iii) Given two lists X= [a, b, c, d, e] and Y = [e, f, g, c, b], generate a new list Z that only contains the common elements between list X and Y.

(4 marks)

(b) Draw conceptual graphs for the following statements:

(i) A particular dog, #1234, is brown

(ii) Mary gave John the book.

(iii) The man bandaged his leg with his own hands.

(iv) The fruit apple tastes sweet

(4 marks)

(c) Briefly describe the four main categories of knowledge representation schemes?

(4 marks)

7. (a) Patients with chest pains are asked to perform ECG tests. Test results are classified as either (+ECG) suggesting heart disease (+HD) or negative (-ECG) suggesting no heart disease (-HD).

Assume that a patient has produced a +ECG. Use Bayes theorem to determine the probability that he may have heart disease, i.e., P(+HD|+ECG). Assume the following probability values obtained from a sample of patients complaining about chest pains.

P(+HD)	= 0.1	10 people out of 100 have heart disease
P(+ECG|+HD)	= 0.9	90 people out of 100 who have +HD will produce +ECG
P(-ECG|-HD)	= 0.95	95 people out of 100 who have -HD will produce a -ECG

(5 marks)

(b) What are the different types of Rules in an Expert System? Give an example for each type.

(3 marks)

(c) Given the rule:

(P1 and P2) or P3 --> R1 (0.7) and R2 (0.3)

where P1, P2 and P3 are premises and R1 and R2 are conclusions. (The CF's for R1 and R2 is 0.7 and 0.3 respectively.) The CF's after a run of the programs for P1, P2 and P3 is as follows:

Premise	**CF**
P1	0.6
P2	0.4
P3	0.5

Calculate the confidence factor (CF) for two rules R1 and R2 when added to the knowledge base.

Use the given Certainty measure for the two premises (P1 and P2) of the rule. Certainty measure for the overall premise is as follows:

CF(P1 and P2) = MIN(CF(P1), CF(P2)).

CF(P1 or P2) = MAX(CF(P1), CF(P2)).

(4 marks)

8. (a) Explain the backpropagation (BP) learning algorithm. Also, give the various mathematical formulas used in the algorithm?

(9 marks)

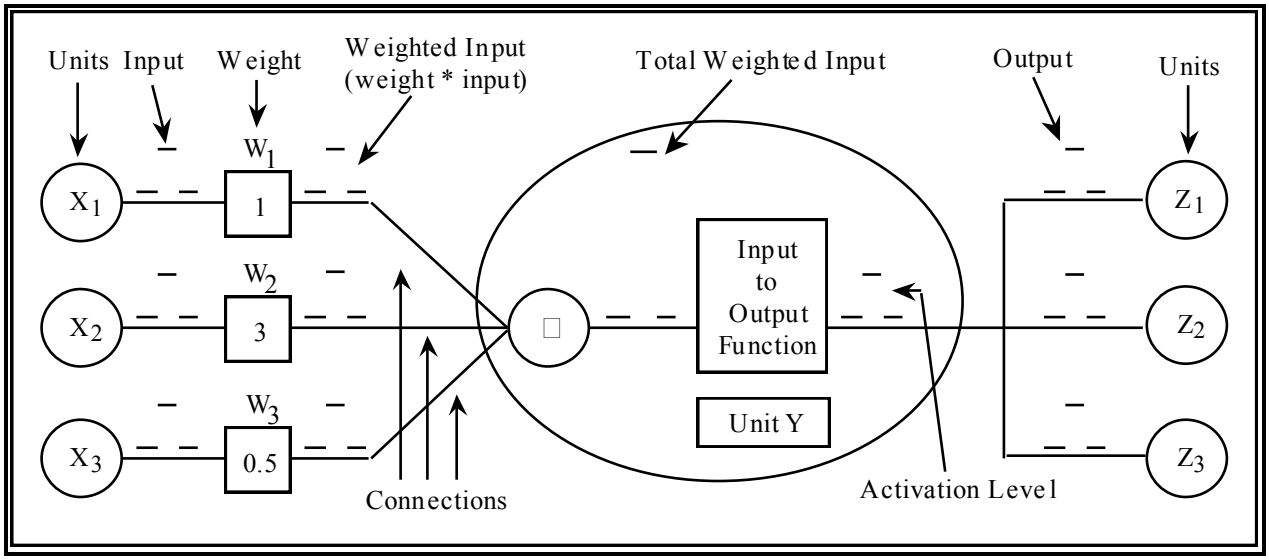
(b) Given the neural network calculate the activation level of the output units Z.

The input values (i.e. activation levels) of the input units are:

$X_1 = 1.0$ $X_2 = 0.5$ $X_3 = 0.9$

Use a threshold Input-Output Function such as:

F(x) = 1.0 if x >= 1.0
F(x) = 0.0 if x < 1.0


Units
Input
Weight
Weighted Input
(weight * input)
Total Weighted Input
Output
Units
X1
X2
X3
W1
W2
W3
1
3
0.5
Input
to
Output
Function
Unit Y
Z1
Z2
Z3
Connections
Activation Level

(3 marks)

9. (a) Given a simple grammar containing a number of rewrite rules and words (terminals) develop a Parse Tree for the following sentence.

"The old man quickly wrote a nice story"

Grammar

sentence	∅	noun_phrase verb_phrase
noun_phrase	∅	noun
noun_phrase	∅	article noun_phrase
noun_phrase	∅	adjective noun_phrase
verb_phrase	∅	verb
verb_phrase	∅	verb noun_phrase
verb_phrase	∅	adverb verb noun_phrase
article	∅	the
article	∅	a
noun	∅	man
noun	∅	story
verb	∅	wrote
adverb	∅	quickly
adjective	∅	old
adjective	∅	nice

(5 marks)

(b) Draw the transition networks for the simple grammar given below?

Sentence	∅	noun_phrase verb_phrase
Noun_phrase	∅	noun
Noun_phrase	∅	adjective noun
Noun_phrase	∅	article noun
Noun_phrase	∅	article noun_phrase
Verb_phrase	∅	verb
Verb_phrase	∅	verb noun_phrase
Noun	∅	man
Noun	∅	dog
Noun	∅	lady
Article	∅	a
Article	∅	the
Verb	∅	saw
Verb	∅	stroked
Adjective	∅	big
Adjective	∅	young

(5 marks)

(c) What is syntactic analysis and how is it achieved?

(2 marks)

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